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An Economic Analysis Of The Effectiveness of Thoroughbred Breeder/Owner Incentive Policies

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ABSTRACT

Thoroughbred incentive programs are subsidy policies funded from state parimutuel tax revenue designed to promote regional race horse breeding and ownership. At issue is an ongoing debate concerning the effectiveness of alternative policies. Empirical results indicate that incentive programs have a positive economic effect, but gains to Thoroughbred breeders can be obtained by reallocating tax revenue to non-restricted purses. A policy allocating tax revenue to non-restricted purses shifts yearling demand and increases prices, while breeder subsidies shift only the supply function and therefore lower prices. Consequently, breeder revenues increase in response to a policy that favors non-restricted purses over subsidies.

Key Words: *incentive programs, parimutuel horse racing, subsidy, tax, Thoroughbred.*

Subsidy policies for agricultural commodities have long been used as a means to stabilize supply and augment demand. Thoroughbred breeder/owner incentive programs are state administered subsidy policies designed to promote regional race horse breeding and ownership. Currently, 28 states operate incentive programs that transfer one-hundred million dollars annually to Thoroughbred breeders and owners (American Horse Council).

Breeder/owner incentive programs are funded through a tax levied on parimutuel wagering pools. This share of tax revenue is transferred to owners and breeders under a variety of alternative subsidy programs. The state of Washington operated an incentive program as early as 1945, and many states initiated incentive programs in the 1960s and 1970s. Each state has different policies regarding the administration and levels of funding across the alternative incentive programs.

Limited analysis exists evaluating the effectiveness of breeder/owner incentive program policies. This is an ongoing concern due to the high levels of expenditures and the limited growth in parimutuel wagering pools across the nation.[1] The objective of this study is to develop an economic framework to evaluate the effectiveness of breeder/owner incentive policies. Effectiveness will be measured relative to incentive policies' effects on the supply of foals registered in a state, the yearling demand as determined by average year-

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[1] Parimutuel horse racing handle increased a marginal 1.6%, $277.4 million, from 1996 to 1997. Since 1982, horse racing's average annual rate of growth has been 2%. Horse racing's market share of total gaming declined 0.41% from 6.80 to 6.39% from 1996 to 1997, and has declined to these levels from a 22% market share in 1982 (Christiansen).

ling price in state sales, and the combined net effects of supply and demand on aggregate breeder revenue.

Background and Literature Review

Each state's incentive program differs in the distribution of transfer payments to the breeders and owners of state-bred horses[2] that win or place in races. Each state has different policies regarding the administration, levels of funding and distribution of payments through some or all five alternative incentive policies. These policies are (1) breeder awards which transfer money to the breeder of record of a state-bred horse, (2) stallion awards which transfer money to owners of stallions standing in the state, (3) restricted race purses which transfer money to the owner of a state-bred horse winning/placing in a race restricted only to state-bred horses, (4) owner awards which transfer money to the owner of a state-bred horse winning a non-restricted race open to all horses meeting the race conditions regardless of state of breeding. Owner awards are comprised of "owner bonuses" where the owner receives incentive payments at the end of the race meet and "purse supplements" where additional purse money for state-bred horses competing in open races are written as part of the race conditions,[3] (5) "other" awards which is a miscellaneous category for state-bred stakes races, stallion stakes, and other races highlighting state-bred horses.

Table 1 shows the distribution of incentive award payments, averaged from 1989 through 1995 for all states operating incentive programs. Restricted race owner awards account for 53 percent of the distribution of incentive award payments. Breeder and stallion awards account for 22 and 5 percent of the distribution of incentive program payments, respectively. Owner awards account for 18 percent of the payment distribution, and "other" awards account for 2 percent.

Table 1. Alternative Breeder Incentive Program Options

Program Option	U.S. Average Incentive Payment Distribution
Breeder Awards	22%
Owner Awards	18%
Stallion Owner Awards	5%
Restricted Purses	53%
Other Awards/Funding	2%

Source: American Horse Council, 1989–1995, average over time and 28 states operating incentive programs. The most current year available for aggregate incentive program data is 1995.

Of particular interest is the wide range in incentive program expenditure per registered foal across the 28 states operating incentive programs (see Table 2). New York and New Jersey rank first and second in incentive program transfer payments, at $11,364 and $11,100, followed by Illinois at $9,660 per foal. Ohio ranks fourth with $5,653 incentive payments per foal. In comparison, Maryland and Washington rank twelfth and fourteenth in expenditures at $2,191 and $1,486 per foal. Kentucky, which ranks first in foal crop, ranks twenty-fifth in incentive payment transfers at $525 per foal. The majority of states, 64 percent, provide $2,208 or less in incentive payment transfers per foal.

Incentive program payments in the Thoroughbred industry work differently than traditional agricultural support programs which transfer payments to eligible producers. Generally, agricultural commodity support programs provide subsidy payments as the difference between the market price and a government support price relative to a farm's production level subject to maximum payment restrictions. Program benefits are not linked to quality or production efficiency targets. In comparison, Thoroughbred incentive pro-

[2] Generally, to be classified as a state-bred, the foal must be conceived in the state and the mare must give birth in the state.

[3] Owner bonuses are paid directly to owners, who are not obligated to share the award with the winning horse's jockey or trainer, and bonuses do not accumulate as part of the horse's race earnings record. Purse supplements are shared with the trainer and jockey, in the same manner as traditional purses, and are included in the horse's race earnings record. Purse supplements are included in purse distribution statistics reported by race tracks and in aggregate state totals.

Table 2. Breeder Incentive Expenditures Per Registered Foal

Rank	State	Foal Crop	Foal Crop Rank	Average Per Foal Incentives[1]
1	New York	1,579	9	11,364
2	New Jersey	581	14	11,100
3	Illinois	1,468	10	9,660
4	Ohio	1,010	11	5,653
5	Louisiana	1,711	6	5,188
6	West Virginia	442	19	4,188
7	California	3,946	2	4,031
8	Pennsylvania	872	12	3,667
9	Nebraska	546	15	3,626
10	Michigan	509	16	3,093
11	New Mexico	636	13	2,208
12	Maryland	1,581	8	2,191
13	Arkansas	457	18	1,686
14	Washington	1,610	7	1,486
15	Arizona	413	20	1,473
16	Oregon	289	22	1,462
17	Oklahoma	1,723	5	1,449
18	Florida	3,784	3	1,381
19	Minnesota	505	17	1,254
20	Massachusetts	125	26	1,088
21	Iowa	192	25	1,049
22	Kansas	243	24	658
23	Wyoming	46	28	635
24	South Dakota	81	27	632
25	Kentucky	7,274	1	525
26	Idaho	347	21	414
27	Colorado	252	23	282
28	Texas	2,294	4	220

[1] Average annual total incentive program transfer payments per registered foal, 1989 to 1995.

grams are only paid to breeders/owners of horses that win races, thereby directly incorporating market-based and clearly defined quality targets. Also, government expenditures on farm commodity support programs are affected by stochastic yields and differences between market prices and target prices. This exposes the government to budget risk. In contrast, Thoroughbred breeder/owner incentive transfer payments are directly linked to a revenue source through the tax levied on parimutuel wagering pools. Breeder and stallion awards are calculated and paid at year-end, after tax revenues are known with certainty. Purses for restricted races and owner awards are set throughout the year and can be adjusted relative to the growth or decline in parimutuel pools. Any carry-over or short-fall in the incentive program funding is recovered in the next calender year, thus eliminating government budget risk.

While there exist a number of studies examining agricultural commodity supply policies (Shumway, Smith, and Richardson; Sun, Kaiser, and Forker) and demand policies (Alston, Carter, and Smith; Halliburton and Henebery), there is limited analysis of the effectiveness of Thoroughbred breeder/owner subsidies.

Degennaro examined the role of sire stakes on the volume of wagering (handle) for harness racing at Scioto Downs racetrack near Columbus, Ohio. Degennaro did not find a direct relationship between parimutuel handle and sire stakes, indicating that the state-bred sire stakes program had no economic impact on wagering.

Model Specification

The hypothesis to be tested is that breeder/owner incentive programs positively affect the supply and demand of Thoroughbred bloodstock. The empirical specification is based on a structural Thoroughbred yearling supply and demand model of inter-temporal equilibrium with price expectations (Neibergs and Thalheimer) augmented to include breeder/owner subsidy programs. The proposed model is a set of state-level Thoroughbred market models as specified by the following three equation system:

Supply of Registered Foals

$$(1)\quad RFOAL_{it} = \alpha_0 + \alpha_1 RFOAL_{it-1} + \alpha_2 P_{it-2} + \alpha_3 BA_{it-2} + \alpha_4 SA_{it-2} + \alpha_5 MTB_{it-2} + \alpha_6 FCI_{it-2} + \alpha_7 SFEE_{it-2} + \mu_{it}.$$

Foal to Yearling Transfer

(2) $YRL_{it} = RFOAL_{it-1}$.

Inverse Demand For Yearlings

$$P_{it} = \beta_0 + \beta_1 YRL_{it} + \beta_2 PRSE_{it} + \beta_3 RPRSE_{it} + \beta_4 OA_{it} + \beta_5 YTB_t + \beta_6 GFP_t + \beta_7 EXR_t + \beta_8 PCI_{it} + \nu_{it} \quad (3)$$

where $i = 1 \ldots n$ represents an index of state level variables.

A working description of the model is provided herein. For a complete model definition and justification of breeder price expectations see Neibergs and Thalheimer. Equation (1) represents a supply model of registered Thoroughbred foals, $RFOAL_{it}$. The model is based on the hypothesis that breeding decisions are dependent on expected yearling price and other supply factors. The decision to breed a mare is made early in year t, which is followed by an 11-month gestation period, to produce and register a foal in year t + 1. The foal matures for a year and is sold as a yearling in year t + 2. Therefore supply decisions are based in part on breeders' price expectations two years in the future.

The Supply Model

Supply response is modeled where $RFOAL_{it}$ responds to state average price for Thoroughbred yearlings lagged two years, P_{it-2}, to represent price expectations and reproductive constraints associated with breeding decisions. Due to the high asset fixity associated with Thoroughbred breeding investments and the long biological lag associated with breeding decisions, the supply of Thoroughbred yearlings changes gradually over time. The stickiness in supply response is in part attributable to the large fixed capital investment associated with horse production that is not easily liquidated, the small difference in marginal cost between a bred mare versus a non-productive barren mare, and the biological constraints of reproduction. Also, many breeders may not be price responsive due to their willingness to subsidize their Thoroughbred investment through periods of non-profitability. A partial adjustment process is represented by a one-period lag of the endogenous variable, $RFOAL_{it}$.

Breeder awards, BA_{it-2}, and stallion awards, SA_{it-2}, are transfer payments to Thoroughbred breeders and are measured in aggregate state totals. They impact the expected returns of breeding decisions and are included in the supply side of the model. Tax benefits are a primary consideration in Thoroughbred investment decisions. Tax benefits are a better indication than tax costs of federal tax policy impacts on the yearling market, because tax benefits apply equally to profitable and non-profitable Thoroughbred investment decisions. The effects of changes in federal tax policy can be captured through an index that measures the present value of tax benefits from a capital investment in a Thoroughbred broodmare (Hall and Jorgenson). The mare tax benefit index, MTB_{t-2}, represents the present value of the tax benefits generated from a fixed capital investment in a Thoroughbred mare.[4] A farm cost index, FCI_{t-2}, represents input costs of production, and $SFEE_{it-2}$, represents the state average advertised stud fee paid to breed a mare. A stochastic error term is represented by μ_{it}.

Foal To Yearling Transfer

Thoroughbred foals are registered with the Jockey Club as weanlings shortly after they

[4] MTB_t and YTB_t are calculated for each year, t, in the time series 1964–1995 as the present value of expected maximum tax benefits from a fixed capital investment in a Thoroughbred breeding mare or yearling, projected over its tax recovery period. For example, MTB_t is calculated as follows:

$$MTB_t = \sum_{n=1}^{N} \frac{T_{tn}D_{tn}}{(1 + r)^n} + \frac{c_{tN}}{(1 + r)^N}$$

for t = 1964 ... 1995

where: n is an annual index relative to year t, and N is the tax recovery period of a mare which is seven years and for a yearling its five years. T_n is the highest personal marginal tax rate, D_n is annual depreciation expense, C_N is the capital gains tax benefit when allowed and 0 otherwise, and the discount rate, r, is fixed at 8 percent. Each tax policy variable is projected over the seven-year tax planning horizon as expected in year t.

are born and become yearlings on the first January 1 after they are foaled. Equation (2) is an identity that transfers $RFOAL_{it}$ to the supply of marketable yearlings, YRL_{it}. Once a foal is registered, only death prevents it from becoming a yearling. Since death loss rates are unavailable and presumed negligible and invariant over time, an identity is used to transfer foals to yearlings.

The Demand Model

Demand for Thoroughbred yearlings can best be represented as a capital investment function. Equation (3) represents an inverse demand function where the state average price of yearlings, P_{it}, is a function of the predetermined supply of yearlings, YRL_{it}, and a set of current exogenous variables. The price of a capital asset, a Thoroughbred yearling being no exception, is related to its earning potential. For Thoroughbred yearlings those earnings are the purses for which they compete plus incentive program transfer payments targeting Thoroughbred yearling/race-horse owners. The state average purse per race, $PRSE_{it}$, restricted race purses, $RPRSE_{it}$, and owner awards, OA_{it}, represent yearling earning potential.

The yearling tax benefit, YTB_t, represents the present value of the tax benefits from a capital investment in a Thoroughbred yearling, and is calculated in the same manner as MTB_t. Foreign investment influences the Thoroughbred yearling market. The gross amount of foreign purchases of Thoroughbred yearlings, GFP_t, and the exchange rate of United Kingdom pounds for U.S. dollars, EXR_t, capture the export influences of demand on the Thoroughbred market. Buyers from the United Kingdom led foreign purchasers for many years of the study. State per-capita income, PCI_{it}, represents regional economic conditions. The stochastic error term is v_{it}.

Because the feedback from the demand equation to the supply equation is a lagged response, the specified model is recursive. In a recursive system, each endogenous variables can be determined sequentially. Given values for P_{it-2}, one can solve directly for $RFOAL_{it}$ in the supply equation. Then, knowing $RFOAL_{it}$, the value of P_{it} can be solved recursively in the demand equation.

Data

Data availability constrained the scope of states included in the model. A number of states failed to maintain an archive of incentive program transfer payments. Other states did not conduct yearling auction sales, so data on P_{it} is unavailable in those states. Three states are included in the model based on the comparability of their Thoroughbred industries. Annual data from 1964 to 1995 for Washington, Maryland and Ohio were analyzed. These states represent a geographical dispersion of Thoroughbred production, and rank seventh, ninth and twelfth in foal crop size in the United States. Over the study period, Washington's incentive program consisted of restricted race purses, owner awards and breeder awards. Maryland's incentive program consisted of restricted race purses, owner awards, breeder awards, and stallion awards. Ohio's incentive program consisted of restricted race purses, owner awards, breeder awards, and stallion awards.

Data on $RFOAL_{it}$ were obtained from *The Jockey Club Fact Book*. Data on P_{it} and GFP_{it} were collected from *Annual Auction Review* (The Blood-Horse) and represent an annual summary of yearling auctions in North America. Data on GFP_t are available only from 1973 to 1995. Prior to 1973 foreign purchases were relatively insignificant and were not reported separately. Essentially GFP_t is a variable with a constant value of 0 assumed for years prior to 1973 and actual data used when GFP_t rose to a level of significance to be reported separately. Data on $PRSE_{it}$ were collected from *The American Racing Manual*. Data on $RPRSE_{it}$, OA_{it}, BA_{it}, and SA_{it} were collected from individual states' annual racing commission reports. MTB_{t-2} and YTB_t were calculated using data from *Standard Federal Tax Reports: Depreciation Guide* and the Internal Revenue Code (Commerce Clearing House). Data on FCI_t were collected from *Agricultural Statistics* (USDA). Data on $SFEE_{it-2}$

were collected from the annual *Stallion Register* (The Blood-Horse). An annual average stud fee was calculated by averaging all advertised stud fees in the register per year for each state in the study. Data on PCI_{it} were obtained from the *Statistical Abstract of the United States*. Data on EXR_t, and the consumer price index used to deflate data expressed in monetary units were obtained from the Citibase Data Base. The sources of data for each of these data series are, respectively, Board of Governors of the Federal Reserve System, Foreign Exchange Rates; and U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index. Descriptive statistics are presented in the Appendix.

Results and Discussion

The specified state level Thoroughbred yearling market model was estimated using Kmenta's method of pooling cross-section time-series data, which assumes autocorrelation and heteroskedasticity (Kmenta). Shazam 8.0 econometrics software was used to estimate model parameters. Due to problems of multicollinearity in the supply model between BA_{it-2} and SA_{it-2}, the relatively small distribution of incentive transfer payments through SA_{it-2}, and since these awards largely target the same Thoroughbred breeder, they were combined into one variable, $BASA_{it-2}$, by adding them together. A dummy variable for Maryland, MADUM, was included in the model, because of an extraordinary price drop which occurred in 1974 to the present. This reflects the export of Maryland's higher quality horses to more lucrative markets in Kentucky and New York through the Fasig-Tipton auction house (Finney). A squared per-capita-income variable, SQPCI, was introduced to better reflect the high disposable income demographic characteristic of yearling investors. Estimated results are presented in Table 3. Overall model results support the suggested model specification, based on the consistency of estimated parameters with what is expected from economic theory, and statistical measures of significance and goodness of fit.

All variables in the supply model are statistically significant and have a Buse R^2 of 0.97. Although $SFEE_{it-2}$ is a production cost and its anticipated sign is negative, the sign on the estimated parameter is positive and insignificant. The incorrect sign is due to the relationship between stud fees and yearling prices. Stud fees are set relative to the strength of the yearling market. This is evidenced by a positive and statistically significant correlation coefficient between P_{it-1} and $SFEE_{it}$, of .333 ($\rho = 0.002$). Breeders are willing to pay increased stud fees as they expect the marginal value product of YRL_{it} to increase as shown by a positive correlation coefficient of .197 ($\rho = 0.063$) between $SFEE_{it-2}$ and P_{it}.

The Buse R^2 in the demand model is 0.84. All model variables except for variables measuring export influences of the market are statistically significant. The states included in the study are regional markets, and typically do not have the quality of horses to attract international buyers. The estimated parameters of PCI_{it} and $SQPCI_{it}$ are negative and positive respectively. These nonlinear results represent the large disposable income demographic characteristics of yearling investors. The key model variables of $PRSE_t$, $RPRSE_t$ and OA_t are statistically significant at a 1-percent level of significance, and $BASA_{t-2}$ is significant at a 2-percent level of significance. All breeder/owner incentive program variables are positive and statistically significant, indicating a positive economic impact. Their elasticities are calculated to evaluate their effectiveness.

Supply and Demand Parameter Elasticities

The short-run supply elasticities and price flexibilities presented in Table 4 are all inelastic, with the exception of $PRSE_t$ which has a price flexibility of 1.108, and PCI_t. The price flexibility of owner award programs OA_t and $RPRSE_t$ are similar at 0.111 and 0.101. Supply response is price inelastic, 0.086, and breeder awards, $BASA_t$ is also inelastic, 0.079. These results are consistent with the elasticities estimated by Neibergs and Thalheimer. The price flexibility of $PRSE_t$ of 1.108 in this study is lower than the purse flexibility of 2.606 estimated in Neibergs and Thalheimer. Two rea-

Table 3. Thoroughbred Breeder/Owner Model Empirical Results

Supply ($RFOAL_t$)			Demand (P_t)		
Variable	Estimated Parameter[1]	Significance Level[2]	Variable	Estimated Parameter[1]	Significance Level[2]
Intercept	−283.71 (61.48)	0.000	Intercept	4779.3 (2191.0)	0.032
$RFOAL_{t-1}$	0.837 (0.035)	0.000	YRL_t	−1.218 (0.659)	0.068
P_{t-2}	$0.167E^{-1}$ ($0.408E^{-2}$)	0.000	$PRSE_t$	0.993 (0.109)	0.000
$BASA_{t-2}$	$0.134E^{-3}$ ($0.565E^{-4}$)	0.020	$RPRSE_t$	$0.389E^{-3}$ ($0.102E^{-3}$)	0.000
MTB_{t-2}	0.993 (0.028)	0.001	OA_t	$0.105E^{-2}$ ($0.505E^{-3}$)	0.040
FCI_{t-2}	−0.238 (0.101)	0.021	YTB_t	1.284 (0.218)	0.000
$SFEE_{t-2}$	0.176 (0.035)	0.000	GFP_t	$0.619E^{-5}$ ($0.399E^{-5}$)	0.126
MADUM	−60.56 (38.82)	0.123	EXR_t	−5.217 (4.714)	0.272
			PCI_t	−111.62 (23.23)	0.000
			$SQPCI_t$	0.236 (0.120)	0.053
			MADUM	−4489.2 (1032.0)	0.000
n	90		n	90	
Buse R^2	0.97		Buse R^2	0.84	

[1] The top number is the estimated parameter and the bottom number in parentheses is the standard error.
[2] Exact probability of rejecting H_0: $\beta_i = 0$.

Variable Definitions: RFOAL = supply of registered foals, P = yearling price, BASA = breeder and stallion awards combined, MTB = mare tax benefit, FCI = farm cost index, SFEE = stud fee, MADUM = dummy variable representing Maryland, YRL = the supply of yearlings, PRSE = purses, RPRSE = restricted purses, OA = owner awards, YTB = yearling tax benefit, GFP = gross foreign purchases, EXR = exchange rate, PCI = per-capita income, SQPCI = PCI squared, t = annual time frame with appropriate lags.

sons may account for the lower response. In Neibergs and Thalheimer the purse variable was an aggregate of purses, restricted purses and owner awards. Second, data was aggregated to a national level in comparison to the state-level data used in this study.

Long-Run Comparative Statics

The derivation of the final form of the model by substituting the supply model, equation (1), into equation (3) takes into account the interaction of supply and demand simultaneously. If a disequilibrating change occurs in the form of a variation in an exogenous variable, the initial equilibrium will be upset. Endogenous variables (RFOAL and P) adjust relative to the new value of the exogenous variable, plus the recursive adjustments between RFOAL and P until long-run equilibrium is reached. Long-run supply elasticities and price flexibilities of key model variables are presented in Table 5. The long-run elasticities determine the relative effectiveness of the alternative breeder incentive programs.

The policy in question is how to effectively allocate state tax revenue from parimutuel taxes to best promote Thoroughbred breeding

Table 4. Short-Run Supply Elasticities and Demand Flexibilities at the Mean

Supply ($RFOAL_t$)		Demand (P_t)	
Variable	Elasticity	Variable	Flexibility
$RFOAL_{t-1}$	0.828***	YRL_t	−0.236*
P_{t-2}	0.086***	$PRSE_t$	1.108**
$BASA_{t-2}$	0.079**	$RPRSE_t$	0.101***
MTB_{t-2}	0.210***	OA_t	0.111**
FCI_{t-2}	−0.131**	YTB_t	0.686***
$SFEE_{t-2}$	0.259***	GFP_t	0.035
		EXR_t	−0.171
		PCI_t	−1.490***
		$SQPCI_t$	0.306**

Notes: One, two and three asterisks indicate statistical significance at the 10%, 5% and 1% level, respectively.

Variable Definitions: RFOAL = supply of registered foals, P = yearling price, BASA = breeder and stallion awards combined, MTB = mare tax benefit, FCI = farm cost index, SFEE = stud fee, YRL = the supply of yearlings, PRSE = purses, RPRSE = restricted purses, OA = owner awards, YTB = yearling tax benefit, GFP = gross foreign purchases, EXR = exchange rate, PCI = per-capita income, SQPCI = PCI squared, t = annual time frame with appropriate lags.

within a state. Each state has the authority to allocate funds to the non-restricted purse account, $PRSE_{it}$, across its breeder award programs, $BASA_{it}$, or to the owner award programs, $RPRSE_{it}$ and OA_{it}. Relative to the objective of promoting regional Thoroughbred breeding, the long-run elasticities indicate that PRSE has the greatest effect on RFOAL with a long-run elasticity of 0.521, followed by BASA with a long-run elasticity of 0.432. BASA is a direct transfer payment to breeders which stimulates foal supply. However, the BASA policy works against itself by decreasing price, since there is a long-run increase in supply without a commensurate increase in demand.

The market intervention effects from a policy decision to introduce or increase BASA are illustrated in Figure 1. Starting at a point of long-run equilibrium, the short-run foal

Table 5. Long-Run Comparative Statics of Key Model Variables

Long-Run Supply (RFOAL)			Long-Run Demand (P)		
Comparative Static	Supply Response[1]	Long-Run Elasticity[2]	Comparative Static	Price Response[1]	Long-Run Flexibility[2]
$\frac{\partial RFOAL}{\partial PRSE}$	0.090	0.521	$\frac{\partial P}{\partial PRSE}$	0.883	0.985
$\frac{\partial RFOAL}{\partial RPRSE}$	$3.540E^{-5}$	0.048	$\frac{\partial P}{\partial RPRSE}$	$3.455E^{-4}$	0.090
$\frac{\partial RFOAL}{\partial OA}$	$0.961E^{-4}$	0.052	$\frac{\partial P}{\partial OA}$	$0.938E^{-3}$	0.098
$\frac{\partial RFOAL}{\partial BASA}$	$7.308E^{-4}$	0.432	$\frac{\partial P}{\partial BASA}$	$-0.891E^{-3}$	−0.102

[1] The result is the evaluation of the comparative static using the estimated coefficients from the supply and demand equations.

[2] Elasticity and flexibility estimates are calculated at the mean.

Variable definitions: RFOAL = supply of registered foals, PRSE = purses, RPRSE = restricted purses, OA = owner awards, BASA = breeder and stallion awards combined, P = yearling price.

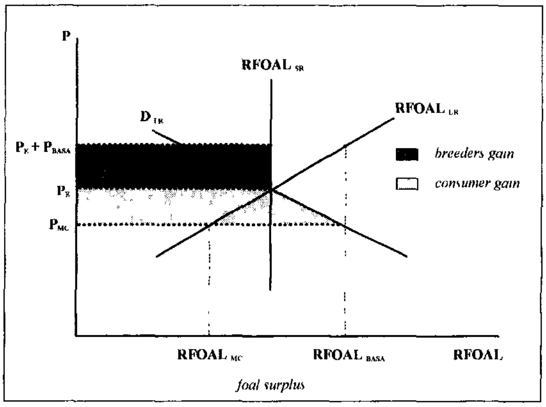

Figure 1. Economic Effects of BASA Policy Introduction

supply, $RFOAL_{SR}$, the long-run foal supply, $RFOAL_{LR}$, and long-run yearling demand, D_{LR} are at equilibrium, resulting in an equilibrium price of P_E. The expansion in BASA transfer payments can be expressed on a per-foal basis as P_{BASA}. The intervention of the BASA expansion policy creates an upward biased price signal of P_E plus P_{BASA}. In the short run, $RFOAL_{SR}$ is perfectly inelastic due to the two-year biological production constraint. Breeders benefit by receiving the equilibrium price plus the breeder awards. The short-run breeder gain, identified in Figure 1 as the darkly shaded rectangle area, is shared among existing breeders based on established BASA distribution policy. In the short run, there is no effect on consumers, or in this case yearling buyers, due to the inelastic supply of foals. In the long run, breeders respond to the upward biased price signal of P_E plus P_{BASA} by increasing the foal supply to $RFOAL_{BASA}$. The long-run supply elasticity of BASA is 0.432. The expanded supply in turn forces a market clearing price decrease to P_{MC}. The long-run price flexibility of BASA is −0.102 (see Table 5). A consumer gain occurs in the long run as supply expands and price decreases, and is identified in Figure 1 as the lightly shaded area. In effect, a foal surplus is created by the non-market intervention of BASA as the difference between $RFOAL_{BASA}$ and the supply of foals relative to P_{MC} of $RFOAL_{MC}$. Net breeder gain in the long run depends on the magnitude of the price flexibility and supply elasticity of BASA. There is no additional long-run breeder gain from BASA. BASA is a target transfer payment based on the level of parimutuel handle, and it is independent of foal supply and price. Therefore as foal supply expands, there is increased competition between breeders for the relatively fixed level of breeder awards.[5]

Table 6. Breeder Revenue From a 10% Increase in Non-Restricted Purses Versus Breeder Awards.

Year	10% Increase in Non-Restricted Purses (PRSE)	10% Increase in Breeder/Stallion Awards (BASA)
	Thousands ($)	
0	8,491	8,491
1	9,637	8,560
2	9,637	8,560
3	9,699	8,604
4	9,727	8,623
5	9,750	8,638
6	9,769	8,650
7	9,783	8,659
8	9,795	8,667
9	9,804	8,673
10	9,811	8,678
11	9,817	8,681
12	9,823	8,684
13	9,826	8,687
14	9,830	8,689
15	9,832	8,691

Breeder revenue is $YRL_t{*}P_t + BASA_t$. $BASA_t = 0$ when analyzing the policy to increase purses.
YRL = the supply of yearlings, P = yearling price, BASA = breeder and stallion awards combined, t = annual time frame.

The breeding sector's marginal revenue would increase by allocating revenue to $PRSE_t$ over $BASA_t$, because $PRSE_t$ provides a positive stimulus to both supply and price. The long-run supply elasticity of PRSE is 0.521, and its price flexibility is 0.985. Table 6 illus-

[5] Breeder awards are relatively fixed once a policy is enacted, because parimutuel handle levels are relatively stagnant. An increase in breeder awards requires a policy change to increase its share of parimutuel tax revenue.

trates the change in total breeder revenue[6] in response to alternative policy scenarios that increases $PRSE_t$ or $BASA_t$ by 10 percent. The analysis is based on using the average for each variable in the model to calculate the initial long-run equilibrium. Starting from a point of long-run equilibrium, year 0, breeder revenue is $8.49 million. Both policy options are initiated in year 1. Considering the policy option to increase $PRSE_t$, P_t responds immediately to the increase in $PRSE_t$, and breeder revenue increases to $9.64 million in year 1. Breeder revenue stays at this level for the two-year time lag required for breeders to adjust supply relative to an exogenous shock. From years 3 to 15, breeder revenue increases to $9.83 million as the market adjusts to a new long-run equilibrium. Under the $PRSE_t$ policy option, it takes 10 years to achieve 95 percent of the adjustment to long-run equilibrium. In contrast, the policy option of increasing $BASA_t$ increases breeder revenue to $8.56 million in years 1 and 2, reflecting the increase in $BASA_t$ transfer payments. Starting in year 3, breeder revenue increases as supply responds to the increase in $BASA_t$, and increases to $8.69 million by year 15. This policy option takes the full 15 years illustrated in the table to achieve 95 percent of the adjustment to the new long-run equilibrium.

The total revenue generated over the 15-year simulation period further illustrates differences between the two policy options. The sum of breeder revenue over the 15-year simulation period is $146.5 million and $129.7 million for the $PRSE_t$ and $BASA_t$ policies, respectively. Comparing the present value of the revenue streams between the two policy options shows additional strength in the $PRSE_t$ policy option. Using a real discount rate of 2 percent, the present value of the stream of breeder revenue over the 15-year simulation period is $125.5 and $111.1 million for the $PRSE_t$ and $BASA_t$ policies respectively. The $14.4 million difference in present value reflects the $PRSE_t$ policy's higher annual revenue, immediate revenue increases, and a faster adjustment to the new long-run equilibrium.[7]

There are additional indirect effects of the BASA policy on breeders. The direct effects are the revenue benefits to breeders when the BASA policy was initiated. However, revenue benefits of price support policies are largely capitalized into the values of land and specialized production resources (Pasour), and the increased capitalized values impede entry into the business by reducing investment profitability. The economic gains to breeders from a policy to increase BASA funding are likely to be short term or transitional as breeder gains are capitalized into higher specialized production input costs: land, broodmares, and stud fees, for example. The distribution of gains between breeders and the owners of specialized production inputs depends on how quickly the expected benefits of policy changes in BASA are incorporated into asset values. The more quickly asset values rise when program benefits are increased, the more asset owners benefit from the gain. Thus the BASA policy results in a transitional gains trap. Once a price support program is in operation, its elimination imposes losses on owners of specialized resources regardless of whether they benefitted from the original windfall.

Conclusions

At issue is an ongoing debate concerning the effectiveness of alternative breeder/owner incentive programs. This study developed an empirical tool to measure the relative effectiveness of alternative Thoroughbred incentive programs to promote the breeding sector. Empirical results indicate that breeder/owner awards have a positive economic effect, but gains in foal supply, yearling demand and breeder revenue can be obtained by allocating revenue to non-restricted purses. Allocating revenue to non-restricted purses shifts demand and increases price, while breeder subsidies

[6] Total revenue to breeders is $YRL_t \cdot P_t + BASA_t$. $BASA_t = 0$ when analyzing the policy to increase purses.

[7] The $14.4 million real (base = 1982–1984) total present value breeder revenue difference between policy options corresponds to a $21.8 million difference in 1995 nominal terms.

shift only the supply function and therefore lower price. Consequently, breeder revenues increase in response to a policy that favors non-restricted purses over subsidies. This policy may have further benefits outside of those identified by this model. Increased purses improve the quality of horses running in a race and may increase the field size of the race, both of which have been shown to increase parimutuel handle (Thalheimer and Ali).

Implementing the policy recommendation of transferring the BASA funding to non-restricted purses will be met with resistance. First, breeder and stallion awards are direct transfer payments to breeders, and they provide a competitive ranking of merit based on the amount of breeder awards received. These utility enhancing aspects of breeder awards are not provided by a policy that increases purses. Second, a policy recommendation to eliminate BASA imposes losses on breeders because of the loss in expected earnings and the loss of capitalizing BASA benefits into the value of specialized resources used in foal production. Policies that redistribute wealth are difficult to change if they adversely affect the interests of well-organized interest groups, such as breeder associations. The results from this study indicate that market-based policies of non-restricted purses, and the resulting competition between horses, is the most effective policy for Thoroughbred breeding.

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Appendix Table. Summary Statistics of Variables in Model System (1966–1995)[1]

Variable	Mean	Standard Deviation	Minimum	Maximum
$RFOAL_t$	1,159	440	362	2,020
$RFOAL_{t-1}$	1,146	452	291	2,020
P_t	5,987	3,138	1,048	13,194
P_{t-2}	5,999	3,149	1,048	13,194
BA_{t-2}	579,930	323,570	0	1,260,900
SA_{t-2}	104,890	133,960	0	446,440
FCI_{t-2}	640	267	270	1,000
YTB_t	3,195	797	1,837	4,569
MTB_{t-2}	2,452	662	1,453	3,732
$SFEE_{t-2}$	1,887	421	1,123	2,555
$PRSE_t$	6,677	3,182	3,565	15,546
$RPRSE_t$	1,555,000	1,673,800	0	6,542,000
OA_t	627,910	759,100	0	2,186,000
GFP_t[2]	33,951,000	35,438,000	0	118,400,000
EXR_t	197	42	130	279
PCI_t	80	38	30	161
$SQPCI_t$	7,775	6,856	912	25,921

[1] All monetary data have been deflated by the consumer price index where 1984 = 100.

[2] Mean, median and standard deviation are calculated using non-zero data from 1973–95.

Variable Definitions: RFOAL = supply of registered foals, P = yearling price, BA = breeder awards, SA = stallion awards, FCI = farm cost index, YTB = yearling tax benefit, MTB = mare tax benefit, SFEE = stud fee, PRSE = purses, RPRSE = restricted purses, OA = owner awards, GFP = gross foreign purchases, EXR = exchange rate, PCI = per capita income, SQPCI = PCI squared, t = annual time frame with appropriate lags.